Customer No.: 31561
Application No.: 10/707,357
Docket No.: 11595-US-PA

IN THE CLAIMS

Please amend the claims as follows.

1. (currently amended) A method of fabricating a ~~deep~~ trench capacitor, comprising:

providing a substrate, wherein the substrate has a patterned liner layer and a patterned mask layer formed thereon and a ~~deep~~ trench formed therein, an electrode formed <u>in the substrate</u> at a bottom of the ~~deep~~ trench ~~in the substrate~~ and a capacitor dielectric layer formed on the surface of the ~~deep~~ trench;

forming a first conductive layer at the bottom of the ~~deep~~ trench;

forming a protective layer over the mask layer and on the surface of the ~~deep~~ trench;

forming a collar oxide layer on the surface of the protective layer;

removing the protective layer and the collar oxide layer on the surface of the first conductive layer;

depositing a material into the ~~deep~~ trench to form a material layer;

removing a portion of the material layer inside the ~~deep~~ trench to form a first opening, wherein a top surface of the material layer is at a level higher than the liner layer;

removing the collar oxide layer and the protective layer not covered by the material layer;

removing a portion of the mask layer and the protective layer on the sidewall of the first opening to form a second opening, wherein the second opening has a width greater than the first opening;

removing the material layer;

depositing conductive material into the ~~deep~~ trench to form a second conductive layer;

removing a portion of the second conductive layer at a top of the ~~deep~~ trench so that the second conductive layer partially fills the ~~deep~~ trench;

removing the collar oxide layer and the protective layer on the sidewall of the ~~deep~~ trench and not covered by the second conductive layer; and

depositing conductive material into the ~~deep~~ trench to form a third conductive layer, wherein the third conductive layer completely fills the ~~deep~~ trench.

2. (original) The method of claim 1, wherein material constituting the protective layer is selected from a group consisting of silicon oxide and silicon oxynitride.

3. (original) The method of claim 2, wherein the step of forming the protective layer comprises performing a plasma-enhanced chemical vapor deposition process.

4. (original) The method of claim 1, wherein the step of forming the collar oxide layer comprises performing a chemical vapor deposition process.

5. (original) The method of claim 4, wherein the step of performing the chemical vapor deposition process comprises using ozone/tetra-ethyl-ortho-silicate as the reactive gases.

6. (original) The method of claim 1, wherein the protective layer has a removal rate smaller than the collar oxide layer.

7. (original) The method of claim 6, wherein the protective layer has a removal rate between about 20 to 35Å/min.

8. (original) The method of claim 6, wherein the collar oxide layer has a removal rate between about 40 to 65Å/min.

9. (original) The method of claim 1, wherein material constituting the material layer is selected from a group consisting of photoresist and anti-reflecting coating.

10. (original) The method of claim 1, wherein the step for removing a portion of the mask layer and the protective layer on the sidewall of the first opening comprises performing a wet etching process.

11. (original) The method of claim 10, wherein the wet etching process is carried out using either hydrofluoric acid/ethylene glycol solution or phosphoric acid solution as the etchant.

12. (original) The method of claim 1, wherein the second opening has a width greater than the first opening by about 5 to 20nm.

13. (currently amended) A method of fabricating a ~~deep~~ trench capacitor, comprising:

providing a substrate, wherein the substrate has a patterned liner layer and a patterned mask layer formed thereon and a ~~deep~~ trench formed therein, an electrode formed <u>in the substrate</u> at a bottom of the ~~deep~~ trench ~~in the substrate~~ and a capacitor dielectric layer formed on the surface of the ~~deep~~ trench;

forming a first conductive layer at the bottom of the ~~deep~~ trench;

forming a collar oxide layer on the surface of the ~~deep~~ trench and the mask layer;

removing the collar oxide layer on the surface of the first conductive layer;

depositing a material into the ~~deep~~ trench to form a material layer;

removing a portion of the material layer inside the ~~deep~~ trench to form a first opening, wherein a top surface of the material layer is at a level higher than the liner layer;

removing the collar oxide layer not covered by the material layer;

removing a portion of the mask layer on the sidewall of the first opening to form a second opening, wherein the second opening has a width greater than the first opening;

removing the material layer;

depositing conductive material into the ~~deep~~ trench to form a second conductive layer;

removing a portion of the second conductive layer at a top of the ~~deep~~ trench so that the second conductive layer partially fills the ~~deep~~ trench;

removing the collar oxide layer on the sidewall of the ~~deep~~ trench not covered by the second conductive layer; and

depositing conductive material into the ~~deep~~ trench to form a third conductive layer, wherein the third conductive layer completely fills the ~~deep~~ trench.

14. (original) The method of claim 13, wherein material constituting the material layer is selected from a group consisting of photoresist and anti-reflecting coating.

15. (original) The method of claim 13, wherein the step for removing a portion of the mask layer on the sidewall of the first opening comprises performing a wet etching process.

16. (original) The method of claim 15, wherein the wet etching process is carried out using either hydrofluoric acid/ethylene glycol solution or phosphoric acid solution as the etchant.

17. (original) The method of claim 13, wherein the second opening has a width greater than the first opening by about 5 to 20nm.

18. (currently amended) A method of fabricating a ~~deep~~ trench capacitor, comprising:

providing a substrate, wherein the substrate has a mask layer formed thereon and a ~~deep~~ trench formed therein, an electrode formed in the substrate at a bottom of the ~~deep~~ trench ~~in the substrate~~ and a capacitor dielectric layer formed on the surface of the ~~deep~~ trench;

forming a first conductive layer at the bottom of the ~~deep~~ trench;

forming a protective layer over the mask layer and on the surface of the ~~deep~~ trench;

forming a collar oxide layer on the surface of the protective layer;

removing the protective layer and the collar oxide layer on the surface of the first conductive layer;

depositing conductive material into the ~~deep~~ trench to form a second conductive layer;

removing a portion of the second conductive layer at a top of the ~~deep~~ trench so that the second conductive layer partially fills the ~~deep~~ trench;

removing the collar oxide layer and the protective layer on the sidewall of the ~~deep~~ trench not covered by the second conductive layer, wherein the protective layer has a removal rate smaller than the collar oxide layer; and

depositing conductive material into the deep trench to form a third conductive layer, wherein the third conductive layer completely fills the ~~deep~~ trench.

19. (original) The method of claim 18, wherein material constituting the protective layer is selected from a group consisting of silicon oxide and silicon oxynitride.

20. (original) The method of claim 19, wherein the step of forming the protective layer comprises performing a plasma-enhanced chemical vapor deposition process.

21. (original) The method of claim 18, wherein the step of forming the collar oxide layer comprises performing a chemical vapor deposition process.

22. (original) The method of claim 21, wherein the step of performing the chemical vapor deposition process comprises using ozone/tetra-ethyl-ortho-silicate as the reactive gases.

Claim 23 (canceled).

24. (currently amended) The method of claim ~~23~~ 18, wherein the protective layer has a removal rate between about 20 to 35Å/min.

Customer No.: 31561
Application No.: 10/707,357
Docket No.: 11595-US-PA

25. (currently amended) The method of claim ~~23~~ 18, wherein the collar oxide layer has a removal rate between about 40 to 65Å/min.